Development of Baculoviral Vectors for Gene Editing of Human Stem Cells

Grant Award Details

Development of Baculoviral Vectors for Gene Editing of Human Stem Cells

Grant Type: Tools and Technologies I

Grant Number: RT1-01028

Investigator:

Name:	Pin Wang
Institution:	University of Southern California
Type:	PI

Human Stem Cell Use: Embryonic Stem Cell

Award Value: $945,604

Status: Closed

Progress Reports

Reporting Period: Year 1

View Report

Reporting Period: Year 2

View Report

Reporting Period: NCE

View Report

Grant Application Details

Application Title: Development of Baculoviral Vectors for Gene Editing of Human Stem Cells

Public Abstract:

Stem cells are powerful undifferentiated cells that are able to both regenerate themselves and differentiate into different mature cell types, such as lung cells or liver cells. The ability to edit stem cell genomes is useful for both understanding stem cells at a fundamental level as well as for practical and therapeutic purposes, such as regenerative medicine. However, there is a current lack of tools available for targeting these cells in a specific and efficient way. Our proposal is to utilize a genetic scissor, which has the ability to target specific sites in the genome, and an engineered delivery vehicle, to site-specifically alter genes of interest in stem cells. This would enable us to correct genetic mutations or deficiencies at known and targeted points in the stem cell genome, which is much more efficient and safer than current methods, which involve random insertion. The random placement of a gene into the stem cell genome could potentially disrupt the production of necessary cellular proteins, which could result in death of the stem cell, or even lead to the development of a cancerous stem cell. Thus, targeting DNA to a specific site has an important advantage over random gene insertion and should be developed and studied further. The success of this proposal has many implications. The methods developed can be used correct inherited genetic diseases such as severe combined immunity disorder (SCID) and sickle cell anemia (SCA) in a safe and efficient way. They can also be used in cell transplantation therapies for diseases such as diabetes, Parkinson's disease, and cardiovascular diseases. Besides these practical applications, the techniques developed can also be used to qualitatively and quantitatively study the molecular mechanisms of stem cells.

Statement of Benefit to California:

We propose to develop a novel and general technology capable of rationally and precisely manipulating the genome of human stem cells (both human embryonic stem cells and induced pluripotent stem cells). This gene targeting tool will provide a unique opportunity to advance our understanding of the role that genetic factors play in controlling the pluripotency and lineage differentiation of human stem cells. This proposal will significantly improve our ability to qualitatively and quantitatively study the molecular regulators in stem cells. The establishment of such a tool in California will enable California to become a world leader in many aspects of stem cell research. In fact, we are determined, in the future, to establish a core facility in California, to help disseminate the technology derived from this study to California stem cell researchers for solving their own challenging problems. This study provides a new approach to safely and efficiently correct the inherited genetic mutations in stem cells that cause many devastating diseases such as severe combined immunity disorder (SCID) and sickle cell anemia (SCA); significant numbers of Californians are afflicted by these types of diseases. This study would also allow us to identify robust conditions to direct the differentiation of pluripotent stem cells to tissue-specific cells, which will benefit many people of California who need cell transplantation therapies for the treatment of diabetes, Parkinson's disease, cardiovascular disease, etc. This new technology can also be employed to genetically modify stem cells for modeling various human diseases, by which new therapies and drugs may be discovered. These new therapies and drugs will not only benefit many individuals in California who bear the corresponding diseases, but they will also inspire and fuel California's biotech industry and benefit general Californians economically.
